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Adapting An Evidence-Based Pediatric Acute Asthma Exacerbation Severity Assessment Tool For Pediatric Primary Care

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ADAPTING AN EVIDENCE-BASED PEDIATRIC ACUTE ASTHMA EXACERBATION SEVERITY ASSESSMENT TOOL FOR PEDIATRIC PRIMARY CARE

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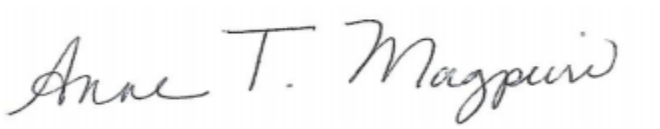

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DISCLOSURES

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KEYWORDS

acute asthma exacerbation, severity assessment, assessment tool, asthma score, pediatrics, primary care

ABSTRACT

Introduction: The purpose of this project was to examine criteria derived from evidence-based pediatric acute asthma exacerbation assessment tools, asthma scores, and the acute asthma prediction rule validated and utilized in the emergency department and to adapt these criteria for pediatric primary care.

Method: Three stages of the project included: (1) identification of criteria in a literature review, (2) validation of the criteria by an expert panel, and (3) adaptation of the criteria in the design of an assessment tool.

Results: The criteria were validated and adapted in the design of "The Pediatric Acute Asthma Exacerbation Severity Assessment and Disposition Decision Making Tool for Pediatric Primary Care."

Discussion: The adaptation of criteria derived from the evidence and validated by an expert panel will inform and guide clinicians in assessing severity and support decision making in determining disposition of pediatric patients presenting with an acute asthma exacerbation in primary care.

In the past two decades, children 5 to17 years old have had the highest asthma prevalence rates as well as the highest exacerbation prevalence rates across all ages. In 2011, four million children less than 18 years old had an exacerbation of which children ages 5 to 17 years old accounted for 77% in this age group (American Lung Association, 2012). Rapid management and treatment must be initiated in children with severe to life threatening exacerbations (U.S. Department of Health and Human Services, 2007). Clinical signs and symptoms are critical to determining the severity level of an exacerbation in children. The ED management of moderate to severe acute asthma exacerbations requires an assessment tool to measure the severity of

asthma in order to provide effective treatment (Van der Windt, Nagelkereke, Bouter, Danker-Roelse, & Veerman, 1994). "Given that pulmonary function testing in the preschool children is often neither feasible nor reliable, many clinical scores of asthma severity have been developed" (Birken, Parkin, & MacArthur, 2004, p.1177).

Since many pediatric patients also present with acute asthma exacerbations in primary care settings, there is a need to implement such tools to guide primary care providers. Such evidence-based asthma assessment tools are imperative to provide guidance for providers in assessing severity level, initiating treatment and determining disposition of pediatric patients with an acute asthma exacerbation in primary care. "The ability to quickly and accurately evaluate acute asthma exacerbation severity is essential for providing appropriate, quality care in an efficient manner" (O'Connor, Berg, Stack, & Arnold, 2015, p. 1). Furthermore, use of an evidence-based asthma assessment tool has the potential to increase patient safety, improve quality of care, and expedite patient flow in the primary care setting. Our purpose was to describe the validation and adaptation of criteria used in the design of the Pediatric Acute Asthma Exacerbation Severity Assessment and Disposition Making Tool for Pediatric Primary Care.

BACKGROUND

There has been great variability in assessing and treating children with an asthma exacerbation due to the fact that children at different age levels, vary in their clinical presentation. As Van der Windt et al. (1994) stated, "A single clinical sign will not be very indicative of asthma severity, but a combination of signs may provide more valid information, considering the complex relationship between the pathophysiological and the clinical features of asthma" (p. 636). Additionally, one method for assessing severity of air way obstruction is by

pulmonary function tests, such as forced expiratory volume at 1 second (FEV_1) and peak expiratory flow. However, young children do not have the capability to perform pulmonary function testing, especially during an exacerbation. Birken, Parkin, and Macarthur (2004) noted that clinical scores for determining asthma severity have been developed because of the significant fact that pulmonary function testing in preschool children is often neither feasible nor reliable. Most of these scores were designed in an "ad hoc" manner and since children less than six years of age were unable to perform pulmonary function tests, clinical signs were the deciding factor in the assessment of acute asthma (Van der Windt et al., 1994). In addition, there was very little if any information on the clinimetric properties of the scores when it came to reliability, validity, and responsiveness whether used in clinical practice or clinical trials (Van der Windt, 2000).

Individual asthma scores assess and measure the severity of asthma in similar ways, but with specific differences between the scores. Most asthma scores use a scoring system by assigning points to presenting clinical signs and symptoms. The first systematic review of asthma scores was completed by Danielle Van der Windt and her colleagues in 1994. Van der Windt et al. (1994) conducted a review of the literature for clinical asthma scores to assess acute asthma exacerbations in pre-school children. Their search identified 16 different clinical asthma scores between 1966 and 1992. These asthma scores were reviewed for: 1) purpose of the score; 2) description of the score; 3) suitability for use in children; 4) inter-observer agreement; 5) validity; and 6) responsiveness. The results were then placed in three different tables, based on the application of the asthma score: 1) discriminative purposes, 2) predictive purposes, and 3) evaluative purposes. Vander der Windt et al. (1994) also noted that most of the asthma scores were not based on empirical evidence, but designed in an "ad hoc manner, on the basis of face

validity only" (p. 637). These scores were not formally developed nor tested using specified performance measures, but created for the purpose of applying a number scoring system to evaluate respiratory signs and symptoms in an acute asthma exacerbation in pediatric patients. Based on their results, the authors concluded that the clinical asthma scores were useful instruments with discriminative and evaluative properties; however, there was insufficient information to justify the use of one asthma score over another. In addition, the predictive validity of the asthma scores was also lacking to allow for application in decision making for discharging or hospitalizing pediatric patients with an acute asthma exacerbation (Van der Windt et al., 1994).

Another study by Birken et al. (2004) was conducted to evaluate the measurement properties of asthma severity scores for use in preschool children. These properties included item development, reliability, validity, responsiveness, and usability. Through a Medline search (1966 to 2002), 10 asthma severity scores (with 19 different clinical variables) were identified for children less than six years old. The study also identified the asthma severity scores developed for use in the inpatient setting (three asthma scores), and the scores developed for use in the ED setting (seven asthma scores). The results showed that the Clinical Assessment Score (CAS) (for use in the inpatient setting) and the Preschool Respiratory Assessment Measure (PRAM) (for use in the ED setting) were the two scores with the "most comprehensive assessment of measurement properties" (Birken et al., 2004, p. 1180). Birken et al. (2004) concluded there is a need for asthma severity scores that are reliable, valid, and responsive for the evaluation and treatment of preschool children with asthma, as well as, for outcome measures when scores are used in clinical trials.

There are other published studies that have included The Pediatric Respiratory Assessment Measure (PRAM) and the Acute Asthma Intensity Research Score (AAIRS). These studies evaluated the clinimetric properties of these asthma scores, for validity, reliability, and responsiveness. The PRAM was originally studied in ages 3 to 6 year olds and later studied in its applicability in children ages 2 to 17 years (Ducharme, et al., 2008). The Acute Asthma Intensity Research Score (AAIRS) is a modification of the PRAM. Scalene muscle retractions in the PRAM was replaced by visual intercostal and subcostal retractions as well as expiratory phase prolongation in the AAIRS (Arnold, Saville, Wang, & Hartert, 2012). The other components of AAIRS are the same as the PRAM including: suprasternal-sternocleidomastoid retractions, air entry, wheezing, and oxygen saturation on room air. The PRAM and the AAIRS were each studied for use in the emergency department setting.

Similarly, Ducharme et al. (2008) conducted a prospective cohort study to examine the validity, responsiveness, and reliability of the Pediatric Respiratory Assessment Measure (PRAM). Responsiveness was examined to determine if the PRAM can detect clinically significant changes over time resulting from treatment. In addition, reliability was assessed by inter-rater agreement of the degree to which a physician and nurse obtained a similar score independently in the same patient. Their study included children ages 2 to 17 years old with acute asthma in which 782 patients had the PRAM recorded at triage. To determine the performance capabilities of the PRAM, the authors also incorporated the expert skills of over 100 nurses and physicians, who were first trained and then performed the PRAM at three different points during the patients' visits: triage, after initial bronchodilation, and disposition. Using disposition as an outcome, Ducharme et al. (2008), were also able to examine the predictive validity and responsiveness of the PRAM. Moreover, the results of the study showed

that the PRAM had good internal consistency and inter-rater reliability for all patients and across all age groups. For this reason, this study was able to validate the PRAM as a reliable pediatric tool to use in ages 2 to 17 years, which was extended beyond the original study of ages 3 to 6 years. Thus, the PRAM was changed from the "Preschool" to the "Pediatric" Respiratory Assessment Measure.

The Acute Asthma Intensity Research Score (AAIRS) is a more recent asthma score and a modified version of the PRAM. Arnold, Saville, Wang, and Hartert (2012) modified the PRAM by eliminating scalene muscle retractions and substituting visual intercostal and subcostal retractions as well as expiratory phase prolongation due to the fact that the PRAM developers had noted that scalene retractions were observed only in 2% of the participants. Arnold, Saville et al. (2012) noted in their study, that scalene muscle retractions were difficult to visually observe in their population of children. Arnold, Saville et al. (2012) in their study, assessed discrimination and responsiveness of the AAIRS in a prospective cohort of children, ages 5 to 17 years old, with acute asthma exacerbation in a pediatric ED. These results were compared to the PRAM. Observing and identifying clinical signs of intercostal and subcostal retractions and expiratory phase prolongation were easier than identifying scalene retractions in younger children. This accounted for a greater range and variability of the AAIRS. The AAIRS demonstrated discrimination and responsiveness similar to the PRAM to predict the criterion standard percentage of predicted forced expiratory volume in 1 second (FEV_1) (O'Connor, Berg, Stack, & Arnold, 2015; Arnold, Saville, et al., 2012). O'Connor, Berg, Stack, and Arnold (2015) conducted another study (including a cohort of 3 to 17 year olds) with the AAIRS and evaluated interrater reliability of each of the components among physicians, nurse practitioners, nurses, and respiratory therapists. They found that respiratory therapists versus physicians or nurse

practitioners had the best total AAIRS intraclass correlation coefficient both before and after treatment. As result of their study, O'Connor et al. (2015) determined that there is good interrater reliability for the overall AAIRS evaluation, yet some components had poor interrater reliability which was attributed to the absence of training with AAIRS. Training prior to administration of the AAIRS may prove beneficial for interrater reliability and should be considered in future studies. Overall, the AAIRS and PRAM are two scores that have been studied and validated and can be used as an assessment tool to evaluate the level of severity of asthma exacerbations in pediatric patients (Ducharme et al., 2008; Arnold, Saville, et al, 2012). A comparison of the performance measures, clinical signs and symptoms, and number of scoring components of the AAIRS and PRAM is presented in Table 1.

Assessment of the severity of an acute exacerbation in children is critical for rapid treatment of severe and life threatening episodes; however, in the primary care setting, assessments are completed in a non-standardized manner. Utilizing the best evidence from current studies, such as those derived with the PRAM and the AAIRS, provides a basis for building upon the evidence-based asthma severity assessment tools validated and utilized in the ED and implementing these tools for use in the pediatric primary care practice. Furthermore, combining the PRAM and AAIRS will allow for application of the assessment tool for a wide range of ages from as young as 2 years old up to and including 17 years old in the primary care setting. This is based on the evidence that the PRAM was validated in ages 2 to 17 years old (Ducharme et al., 2008) and the AAIRS was not validated for ages younger than 5 years (Arnold, Saville, et al., 2012). Even in later studies, the AAIRS was only validated for ages 3 years and older (O'Connor et al., 2015). Furthermore, by combining the PRAM and the AAIRS, this leads to an assessment tool inclusive of eight components of clinical signs and symptoms from both

the PRAM and the AAIRS. The National Asthma Education and Prevention Program (NAEPP) (2007) recommends that all clinicians should be fully prepared to manage an asthma exacerbation and be able to recognize signs and symptoms of severe and life threatening exacerbations. The need for a standard assessment tool for reliably determining the severity level of an asthma exacerbation in pediatric patients is paramount for rapid evaluation and treatment for clinicians both in the ED and primary care setting. However, for children there is no single assessment tool that appears to be the preferred tool for assessing the severity of an asthma exacerbation, evaluating response to treatment and predicting hospitalization (U.S. Department of Health and Human Services, 2007).

Arnold, O'Connor, and Hartert (2015) conducted a study in which the AAIRS demonstrated predictive validity for admission to the hospital or PICU. Additionally, Arnold, Gebretsadik, Abramo, Sheller, et al. (2012) initiated the Acute Asthma Severity Assessment Protocol (AASAP) study to develop an asthma clinical prediction rule in 2010. This development of the Pediatric Acute Asthma Prediction Rule (APR) for hospitalization was internally validated as a tool that is specific for providing the information needed for decision making in admitting pediatric patients to the hospital. The APR was based on the concept of a clinical prediction rule (CPR), which is a decision-making tool that incorporates two or more variables from the history, physical exam, or additional tests to predict the probability of an event or intervention in admitting a patient (Arnold, Gebretsadik, Abramo, Moons, et al., 2014).

Arnold, Gebretsadik, Abramo, Moons, et al. (2014) conducted the APR study with a prospective cohort of 928 patients, between ages 5 to17 years old, with acute asthma exacerbations who presented to the ED and who were enrolled between April 2008 and February 2013. Part of their assessment included candidate predictor variables, such as patient

demographics, patient asthma characteristics, pulmonary exam findings, and measures of lung function and inflammation (Arnold, Gebretsadik, Abramo, Moons, et al., 2014). These researchers indicated that this is most likely the first CPR for acute asthma exacerbations. This study provided modeling and internal validation for an APR for children with acute asthma exacerbations, between ages 5 to 17 years old. Furthermore, the predictor variables are clinically accessible and readily available at the time patients present for triage and before treatment. This information is helpful for providers to use in their practice along with significant patient characteristics such as: "prevalence of uncontrolled chronic asthma measured with Global Initiatives for Asthma (GINA) criteria, second-hand smoke exposure, prior PICU admission for asthma, and reported use of inhaled corticosteroids" (Arnold, Gebretsadik, Abramo, Moons, et al., 2014, p. 234). Arnold, Gebretsadik, Abramo, Moons, et al. (2014) concluded that the APR has the potential to not only improve outcome prediction at the time of ED presentation, but may also improve triage, patient management, and resource utilization.

The lack of a structured process to assess the severity level of an acute exacerbation in children in the primary care setting has not been addressed in the literature. Although there have been numerous published studies in pediatric emergency literature, there is a gap in the literature regarding severity assessment processes in pediatric primary care.

METHODOLOGY

This project describes the evidence regarding asthma scores to assess the severity level of an acute asthma exacerbation in pediatric patients as these scores are primarily utilized in the ED. Using this evidence, the project incorporated the design of an evidence-based asthma severity assessment tool for primary care practice through three specific stages: (1) identification and selection of criteria based on a review of the literature, (2) validation of the criteria identified

in the literature review by a panel of content experts, and (3) adaptation of the criteria into an asthma severity assessment tool to guide clinicians in the pediatric primary care setting.

The criteria for the asthma severity assessment tool were identified through a literature review that included using Pub Med, Ovid, Cochrane Library, Medline, UpToDate, SCOPUS, and CINAHL. Through a comprehensive literature search, articles were found on the management of an acute asthma exacerbation in an emergency room/department or inpatient setting for pediatric patients. None of these articles included the assessment or treatment for pediatric patients presenting with an acute asthma exacerbation in the primary care setting. Articles that were excluded contained information regarding the assessment of severity of acute asthma exacerbation in adults. Through the literature search, recent studies by Arnold and his colleagues on assessing the severity of acute asthma exacerbations in children and predicting the need for hospitalization were found informing asthma hospitalization decision making and resource utilization for clinicians treating and managing children with acute asthma exacerbations. The content derived from the literature review for identifying and selecting criteria was built into a table and designed as a scoring sheet for the expert panel to input their ratings.

The second stage included validation of the criteria for the asthma severity assessment tool based on review by a panel of five experts (see Table 2). The selection of the expert panel was in accordance with the guidelines for validation of content in evidence-based projects as set forth by the Yale School of Nursing faculty (Lazenby, Dixon, Coviello, & McCorkle, 2014). The expert panel included one primary care pediatrician, three nurse practitioners (two specializing in childhood asthma and two certified as asthma educators), and one pediatric pulmonologist. Validation took place with two rounds of the expert panel review between July and September

2016. The scoring sheet for the first round included the rating dimensions for whether the category should be included (labeled "include category?"), "clarity," and "relevance." The next step in this stage included the validation of expert ratings, which is analogous to content validation of new tools. Calculation of Content Validity Index (CVI) was based on established procedures as described by Polit, Beck, and Owen (2007). CVI by item (I-CVI) is computed by the number of experts responding with positive relevance rating divided by the number of experts, thus reflecting proportion of experts who judge the item to be relevant (Polit, Beck, & Owen, 2007, p.460). Scale CVI/Average (S-CVI/Ave) is the average of I-CVI across the items of a scale or tool. Excellent content validity is indicated by I-CVI value of .78 or greater for all items, as well as S-CVI/Ave value of .90 or greater for the entire scale. Based on the first round, calculations of I-CVI and S-CVI/Ave values, a second round was needed to reach consensus by the expert panel. The scoring sheet was revised and included rating dimensions of "clarity," "relevance," and "feasibility." Subsequently, calculations for I-CVI and S-CVI/Ave values were completed for the second round.

The design of the asthma severity assessment tool was the third and final stage. The validated criteria were integrated into an excel spreadsheet and through several versions, an user friendly assessment tool was developed. In addition, the criteria were organized so as to be used as an informative guideline for primary care providers during a patient visit. It was intended that primary care providers would be able to easily use the assessment tool for the purpose of documentation and tracking information obtained from the assessment and management of pediatric patients (ages 2 to 17 years old) presenting with an acute asthma exacerbation in the primary care setting. No Institutional Review Board approval was necessary for this project as it

was a literature review to develop an evidence-based assessment tool and validated by a panel of content experts.

RESULTS

Taken together, the criteria identified from the literature review and validated by the expert panel were incorporated into the design of the Pediatric Acute Asthma Exacerbation Severity Assessment and Disposition Decision Making Tool for Pediatric Primary Care (Ages 2 years old up to and including 17 years old). Despite the fact that the literature provided no evidence specific to pediatric primary care, the literature review did reveal that the best evidence for the assessment of the severity of an acute exacerbation in children supports criteria from the Pediatric Respiratory Assessment Measure (PRAM) and Acute Asthma Intensity Research Score (AAIRS). Additional criteria for determining disposition were based on the evidence derived from studies on The Asthma Prediction Rule (APR).

All five invited experts independently validated the criteria; however, number of responses varied by item. In the first round, under the dimension of "Relevance," only 58% of the items met the goal of I-CVI > .78. In addition, a S-CVI/Ave value of .79 was obtained under "Relevance," which was also below the goal of S-CVI/Ave >.90. In short, results from this first round, including comments from the experts, indicated a need for further explanation for several of the items. Based on the results of the first round, a second round was conducted. In the rating sheet used for the second round, several items were revised, "feasibility" was added as a rating dimension (replacing "include category"), Global Initiatives for Asthma (GINA) was decomposed into five items to be rated separately, and additional information was provided. Also, in the section on clinical signs and symptoms, the experts were asked only to rate "scalene" retractions, as other items of the section had met the goal of I-CVI > .78 agreement in the

dimension “Relevance.” This was needed because experts rated “scalene” retractions very low for “Relevance” (I-CVI value of .60) in the earlier round. Additionally, as part of the second round, a draft of the resulting asthma severity assessment tool was provided to the experts along with the scoring sheet. Experts were given the option to provide comments on the draft. The draft of the tool also included detailed information of the GINA Assessment for Symptom Control on the back side of the page.

Four of the five experts participated in the second round. Due to incomplete responses, a follow-up inquiry was conducted with some of the experts. These follow-up responses were added to the final tally of the expert panel scores and are reflected in results reported in Tables 3 and 4. Table 3 provides a comparison of ratings on the dimension of “Relevance” by specific criteria in Round 1 and 2 of the expert panel review. Table 4 displays a summary of the percent of items which received I-CVI values > .78 and < .78, and S-CVI/Ave values for both rounds of the expert panel review. Only about half of the items met the goal of > .78 to be considered excellent content validity in Round 1, indicating need for some revisions, and an additional round of review. In Round 2, the percent of the revised set of items with an I-CVI value > .78 was generally increased -- .79, .53, and .68, for clarity, relevance, and feasibility respectively. All S-CVI/Ave values in Round 1 were less than the goal of > .90 to attain excellent content validity. In contrast, the S-CVI/Ave values were higher in Round 2 -- .93, .86, and .90, respectively for clarity, relevance, and feasibility. Thus, “Clarity” and “Feasibility” met the goal for excellent content validity; whereas, “Relevance” was only slightly below the goal. Overall, the results from Round 2 of the expert panel review established content validity for inclusion of items rated by the expert panel, excluding a few items that did not meet the goal. Decisions made for these items for criteria inclusion were conducted separately.

In making decisions about the final version of the Pediatric Acute Asthma Exacerbation Severity Assessment and Disposition Decision Making Tool to be implemented, evidence obtained through our comprehensive review was integrated with expert ratings, leading to decisions to retain some criteria, despite not having achieved desired levels for validation. These criteria included: "Scalene" retractions, "Inspiratory to Expiratory Ratio," as well as a few items under "Socially at Risk," "Patient Information," and "The GINA Assessment for Symptom Control." These criteria were all retained due to the supporting evidence and associated validation provided in published studies. It is noted that for each criterion in Round 2 that were accepted despite lower than ideal level, there was disagreement by only one of the four experts. (With fewer than five experts, only consensus agreement achieves I-CVI of greater than .78.) Furthermore, a S-CVI/Ave value of .86 for "Relevance" was determined to be sufficient for moving forward with implementation of the tool for the same reason that the criteria were derived from evidence in the literature. These results may appear less than fully optimal for retaining criteria; thus, these criteria will be evaluated further in going forward with the implementation of the tool in pediatric primary care practice.

In the third stage of the project, the validated criteria were incorporated into the Pediatric Acute Asthma Exacerbation Severity Assessment and Disposition Decision Making Tool for Pediatric Primary Care (Ages 2 years old up to and including 17 years old). General information for date, time of arrival and time of discharge, as well as a form tracking number are requested at the top portion of the assessment tool. Next, two primary sections were designed. The first section is designated as the "Assessment for Severity of an Acute Asthma Exacerbation" and builds on the foundation of evidence from the Acute Asthma Intensity Score (AAIRS) (Arnold, Saville et al., 2012) and the Pediatric Respiratory Measure (PRAM) (Ducharme et al., 2008). By

combining the PRAM and the AAIRS, this leads to an assessment tool inclusive of eight components of clinical signs and symptoms and resulting in a 19 point system for scoring. This section reflects the evel of severity of an acute exacerbation of a child based on clinical signs and symptoms upon arrival and after each treatment given in the primary care setting. The first section also includes a sub-section, "Treatments Administered During Visit," to collect information of medications and oxygen administered for each treatment. The second primary section of the assessment tool is titled, "Determination for Disposition." This section includes sub-sections: 1) "Patient Information" and, 2) "Disposition." Additionally, the "GINA Assessment of Symptom Control" (with detailed instructions in calculating the level of symptom control on back page), "Current Medications," and "Socially at Risk" are found under the sub-section of "Patient Information." Lastly, the criteria of "Disposition" is located at the end of the assessment tool and includes "Length of Stay" (from less than 30 minutes to > 2 hours) and "Discharge to: Home, ED, Hospital Admission" (inpatient or Pediatric Intensive Care Unit (PICU). The primary care providers completing the assessment will be able to enter their information in the last row. The form is also designed with designated colors for each section and sub-section. It can be completed by entering information on a hard-copy or digitally and incorporated into any medical record whether hard-copy or electronic medical record (EMR). The front and back pages of the Pediatric Acute Asthma Exacerbation Severity Assessment and Disposition Decision Making Tool for Pediatric Primary Care are shown in Table 5.

DISCUSSION

The literature review indicated there are several asthma scores that have been evaluated for their performance; however, to date there is no single preferred tool that is utilized in assessing pediatric patients with an acute exacerbation in either the ED or primary care. Recent

literature supports the need for a standardized assessment tool to assess the severity of an acute asthma exacerbation in pediatric patients in the ED. However, these findings can also be extended to providers in the pediatric primary care setting where a dearth of evidence exist for assessing the severity level of an acute exacerbation. The purpose of this project was to examine criteria derived from evidence-based pediatric acute asthma exacerbation assessment tools, asthma scores, and the acute asthma prediction rule validated and utilized in the emergency department (ED) and to adapt these criteria for clinical practice in pediatric primary care.

Our results may facilitate the clinical process for rapidly assessing and initiating treatment for an acute exacerbation in pediatric patients that could be potentially severe or life-threatening in the primary care setting. This asthma severity assessment tool includes criteria founded on the evidence from the Acute Asthma Intensity Research Score (AAIRS), Pediatric Respiratory Assessment Measure (PRAM), and the Pediatric Acute Asthma Prediction Rule for Hospitalization (APR). The implementation of this assessment tool may promote the effective management of pediatric asthma patients with an acute asthma exacerbation in the primary care setting. Overall, this assessment tool has the potential to enhance patient safety, improve quality of care and expedite patient flow in primary care pediatric settings.

CONCLUSION

Assessing the severity level of an acute asthma exacerbation in children is key to rapid management and treatment in the primary care setting. The results of this project will inform primary care providers in improving clinical practice with an evidence-based pediatric asthma severity assessment tool. The next step will examine primary care providers' perception of the feasibility, usability, and acceptability of this evidence-based asthma severity assessment tool in improving the assessment process for children presenting with an acute asthma exacerbation.

The implementation of an evidence-based pediatric asthma severity assessment tool is paramount in meeting the need for a standardized tool for guiding providers in the pediatric primary care setting. Ultimately, the goal of this evidence-based project is to improve providers' skills to facilitate accurate assessment, treatment, and decision-making in the disposition of pediatric patients with an acute asthma exacerbation in primary care.

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Table 1. Comparison of Asthma Scores

	SCORING COMPONENTS			PERFORMANCE MEASURES					
Score	**# of Components**	**Range of Scores**	**Ages (years)**	**Reliability**	**Validity**	**Responsiveness**	**Usability**	**Discriminative Ability**	**Predictive Ability**
PRAM	5	0-12	2 to 17	X	X	X	X	X	X
AAIRS	7	0-16	5 to 17	X	X	X		X	X
	SEVERITY LEVEL								
Score	Mild	Moderate	Severe						
PRAM	1 to 3	4 to 7	8 to 12						
AAIRS	1 to 6	7 to 11	12 to 16						
CLINICAL SIGNS AND SYMPTOMS									
Score	**Oxygen Saturation**	**Wheezing**	**Inspiratory to Expiratory Ratio**	**Air Entry**	**Suprasternal-Sternocleido-mastoid Retractions**	**Scalene Retractions**	**Intercostal Retractions**	**Subcostal Retractions**	
PRAM	X	X		X	X	X			
AAIRS	X	X	X	X	X		X	X	
(References: Ducharme et al., 2008; Arnold, Saville, Wang, & Hartert, 2012)									

Table 2. Comparison of Expert Panel Review - Round 1 and 2

Round 1 and Round 2
Comparison of Relevance Ratings by Item
Expert Panel Review

ROUND					
1 (n = 5 Experts)			2 (n = 4 Experts)		
CRITERIA	Number of Experts Responding [a]	Relevance - %Agreement (I-CVI Value) [b]	CRITERIA	Number of Experts Responding [c]	Relevance - %Agreement (I-CVI Value) [b]
Clinical Signs/Symptoms			Clinical Signs/Symptoms		
Oxygen Saturation(SPO2) on Room Air	5	100%			
Acessory Muscle Use:					
1) Intercostal	5	100%			
2) Subcostal	5	100%			
3) Sternocleidomastoid	5	80%			
4) Suprasternal	4	100%			
5) Scalene	5	60%	Accessory Muscle Use: Scalene	4	75%
Inspiratory to Expiratory Ratio	2	100%			
Wheezing	5	100%			
Air Entry	5	100%			
			Treatments Administered during Visit: Yes or No		
			Albuterol Treatments (Solely)	3	100%
			Albuterol & Ipratropium BromideTreatments	3	100%
			Oral Corticosteroid Treatment	3	100%
			Oxygen	3	100%
Patient Information			Patient Information		
1) Age	3	67%	Age: 1) 2-4yrs; 2) 5-10yrs; 3) 11-17yrs	4	75%
2) Gender	5	20%	Gender: Male or Female	4	75%
3) Race	5	40%	Race/Ethnicity: African American, White, Asian, Hispanic or Latino, Other	4	75%
4) Insurance Status	0		Insurance Status: Private, Public, Not Insured	4	100%
2) Previous Hospitalization	4	100%	Hospitalization(s) in year prior for asthma	4	75%
3) Previous PICU Admission	4	100%	PICU Admission(s) in year prior for asthma	4	75%
4) Global Initiatives for Asthma (GINA): Nocturnal Awakenings during 3 months preceding visit	4	75%	Global Initiatives for Asthma (GINA) Assessment for Symptom Control in past 4 weeks:		
Family Asthma History	5	40%	1) Daytime sx 2/wk; Ages ≤ 5, more than few min, > 1/wk	3	67%
			2) Nocturnal Awakenings sx > 1/wk; Ages ≤ 5, any night waking or night cough due to asthma	3	67%
			3) Activity Limitation	3	100%
			4) Need for Reliever Med/Albuterol > 2/wk; Ages ≤ 5, Need 1/wk	3	67%
			5) Asthma Exacerbation tx with oral CCS (in year prior)	3	67%
			Current Medications:		
Medications in use	4	75%	Prescribed Inhaled Corticosteroid Yes or No	3	100%
1) Corticosteriod Treatment in Preceding Year	4	100%	Inhaled Corticosteroid Administered or Used Daily in Past 4 Weeks: Yes, Sometimes, No	3	100%
Second Hand Smoke Exposure	2	100%	Socially at Risk (Circle All That Apply): Unsafe housing; Homeless shelter; Parent unable to provide care; Exposures: Smoking, Pets, Roaches, Mold, Other	2	100%
Disposition:			Disposition:		
Arrival Time/Disposition Time/ Length of Stay	5	60%	Arrival Time/Disposition Time/ Length of Stay: 1) 0-30 minutes; 2) 30 min to 1hr; 3) 1-	3	100%
Disposition (D/C to Home or Hospital Admission)	5	80%	Disposition: Home or Emergency Department; Hospital Admission: Inpatient or PICU	3	100%
Feasbility (Ease of Use)	0				
S-CVI/Ave Value [d]		0.79	S-CVI/Ave Value [d]		0.86

[a] Although 5 experts participated in Round 1, number of responses varied by criteria from 0 to 5, with only 12 criteria rated by all experts. Item-level Content Validity Index (I-CVI) calculations are based on number responding to each criteria respectively.

[b] Ratings of relevance were elicited as a dichotomous choice in both records: either "not at all" relevant or "very " relevant.

[c] Although 4 experts participated in Round 2, number of responses varied by criteria from 0 to 4, with only 7 criteria rated by all experts. I-CVI calculations are based on number responding to each criteria respectively.

[d] Calculation of Scale-level Content Validity Index Average (S-CVI/Ave) was based on 19 criteria in each round.

Table 3. Summary of Content Validity Index (CVI) Values of Expert Panel Review Round 1 and 2

EXPERT PANEL REVIEW						
			ROUND			
		1[a]			2[b]	
	I-CVI Value			I-CVI Value		
DIMENSIONS	> .78	< .78	S-CVI/Ave Value	> .78	< .78	S-CVI/Ave Value
Include Category?	41%	59%	88%			
Clarity	64%	36%	84%	79%	21%	93%
Relevance	58%	42%	79%	53%	47%	86%
Feasibility				68%	32%	90%

[a] In Round 1, 23 items were rated. Of these, 22 were included in the Item-level Content Validity Index (I-CVI) computations and 19 were included in Scale-level Content Validity Index Average (S-CVI/Ave) computations. I-CVI calculations are based on number responding to each criteria respectively.

[b] In Round 2, 21 items were rated. Of these, 19 were included in I-CVI and S-CVI/Ave computations. I-CVI calculations are based on number responding to each criteria respectively.

Table 4. Pediatric Acute Asthma Severity Assessment and Disposition Decision Making Tool

PEDIATRIC ACUTE ASTHMA EXACERBATION SEVERITY ASSESSMENT and DISPOSITION DECISION MAKING TOOL FOR PEDIATRIC PRIMARY CARE (AGES 2 YEARS OLD UP TO AND INCLUDING 17 YEARS OLD)					FORM TRACKING #_____
DATE:					
Interval (*Assessment at arrival and after each treatment)	Arrival (Baseline)	1st Treatment	2nd Treatment	3rd Treatment	
Time:					
ASSESSMENT FOR SEVERITY OF AN ACUTE ASTHMA EXACERBATION (References: Acute Asthma Intensity Research Score (AAIRS): Arnold, Saville, Wang, & Hartert, 2012; Berg, O'Connor, Lescallette, & Arnold, 2015. Pediatric Respiratory Assessment Measure (PRAM): Ducharme, et al., 2008)					
CLINICAL SIGNS/SYMPTOMS:					COMMENTS
INTERVAL* (Enter score in each box)	Arrival (Baseline)	1st Treatment	2nd Treatment	3rd Treatment	
SpO_2 (on room air): 0= ≥ 95%, 1= 92%-94%, 2= < 92%					
Retractions: (0=Absent, 2=Present)					
Suprasternal-Sternocleidomastoid (SCM)					
Intercostal					
Subcostal					
Scalene					
Auscultation:					
Air Entry: 0=Normal, 1=Decreased at bases, 2=Widespread Decrease, 3=Absent or Minimal					
Wheezing: 0=Absent, 1=Expiratory, 2=Inspiratory and Expiratory, 3=Audible without stethoscope					
Expiratory Phase (Inspiratory:Expiratory Ratio): 0=Normal, 1:1; 1=Prolonged, 1:2; 2=Severely Prolonged, ≤ 1:3					
OVERALL SCORE					
SEVERITY: 1-6 Mild; 7-12 Moderate; 13-18 Severe					
Treatments Administered During Visit:					
1) Albuterol Treatments (Solely)		□ Yes □ No	□ Yes □ No	□ Yes □ No	
2) Albuterol and Ipratropium Bromide Treatments		□ Yes □ No	□ Yes □ No	□ Yes □ No	
3) Oral Corticosteroid Treatment		□ Yes □ No	□ Yes □ No	□ Yes □ No	
4) Oxygen		□ Yes □ No	□ Yes □ No	□ Yes □ No	
DETERMINATION FOR DISPOSITION (Reference: Pediatric Acute Asthma Prediction Rule (APR): Arnold, Gebretsadik, Moons, Harrell, & Hartert, 2014)					
PATIENT INFORMATION:					COMMENTS
Age: _____ years old					
Gender: □ Male □ Female					
Race/Ethnicity: □ African American □ White □ Asian □ Hispanic or Latino □ Other _____					
Insurance Status: □ Private □ Public □ Not Insured					
Hospitalization(s) in year prior for asthma: □ Yes □ No					
PICU Admission(s) in year prior for asthma: □ Yes □ No Intubated □ Yes □ No					
Global Initiatives for Asthma (GINA) Assessment of Symptom (sx) Control in past 4 weeks: (Details on Back Page)					Global Strategy for Asthma Management & Prevention 2016
1) Daytime sx: > 2/wk [Children ≤ 5yrs: Daytime sx more than a few minutes, > 1/wk]: □ Yes □ No					
2) Nocturnal Awakenings sx > 1/wk [Children ≤ 5yrs: Any night waking or coughing due to asthma]: □ Yes □ No					
3) Activity Limitations: □ Yes □ No					
4) Need for Reliever Medication/Albuterol > 2/wk [Children ≤ 5yrs: Reliever Medication > 1/wk]: □ Yes □ No					
Level of Asthma Symptom Control (# of Yes): □ Well-Controlled = None; □ Partly Controlled = 1-2; □ Uncontrolled = 3-4					
Asthma Exacerbation treatment with oral corticosteroid (in year prior): □ Yes □ No					
Current Medications:					
Previously Prescribed Inhaled Corticosteroid: □ Yes □ No					
Inhaled Corticosteroid Administered or Used Daily in Past 4 Weeks: □ Yes □ Sometimes □ No					
Socially at Risk: □ Unsafe housing □ Homeless shelter □ Parent/Guardian unable to provide care; Exposures: □ Smoking □ Pets □ Roaches □ Mold □ Other_____					
DISPOSITION:					COMMENTS
Length of Stay: □ 0 - 30 minutes □ 30 minutes to 1 hr □ 1 to 2 hrs □ > 2hrs					
Discharge to: □ Home □ Emergency Department; Hospital Admission: □ Yes □ No If Yes: □ Inpatient □ PICU					Discharge Time: _____
Provider's Name/Date (Completed Assessment):					(Updated: 4 March 2017)

(Back Page)
DETAILS FOR PATIENT CHARACTERISTICS USING THE GLOBAL INITIATIVE FOR ASTHMA

In 1989, the National Asthma Education and Prevention Program (NAEPP) was originally started to address the growing problem of asthma in the United States under the National Heart, Lung, and Blood Institute (NHLBI). In 1993, the National Heart, Lung, and Blood Institute (NHLBI) collaborated with the World Health Organization (WHO) and produced a report that led to the establishment of the Global Initiative for Asthma (GINA) to treat and manage asthma as a global health problem for all ages. Both programs provide evidence-based guidelines for the treatment and management of asthma. Dr. Donald Arnold incorporated the GINA Strategy for Asthma Management and Prevention 2014 in his studies for identifying patient characteristics in the Asthma Prediction Rule for Hospitalization (Arnold et al., 2014).

GINA Assessment of Asthma Control:
(Global Initiative for Asthma (2016). Global Strategy for Asthma Management and Prevention 2016)

Level of Asthma Symptom Control:
Well-Controlled=None; Partly Controlled=1-2 Yes; Uncontrolled=3-4 Yes

Adults, adolescents, and children 6-11 years old: (Box 2-2, GINA 2016, p. 29)
In the past 4 weeks, has the patient had:
1) Daytime asthma symptoms more than twice/week?
2) Any night waking due to asthma?
3) Reliever needed for symptoms more than twice/week?
4) Any activity limitation due to asthma?

Specific Question for children 6-11 years:
1) Day Symptoms: How often does the child have cough, wheeze, dyspnea, or heavy breathing (number of times per week or day)? What triggers the symptoms? How are they handled?
2) Night Symptoms: Cough, awakenings, tiredness during the day? (If the only symptom is cough, consider rhinitis or gastroesophageal reflux disease)
3) Reliever Use: How often is reliever medication used? (check date on inhaler or last prescription). Distinguish between pre-exercise use (sports) and use for relief of symptoms.
4) Level of Activity: What sports/hobbies/interests does the child have, at school and in their spare time?
5) How does the child's level of activity compare with their peers or siblings? Try to get an accurate picture of the child's day from the child without interruption from the parent/carer.

Children 5 years and younger: (Box 6-4, GINA 2016, p. 105)
In the past 4 weeks, has the child had:
1) Daytime asthma symptoms for more than a few minutes, more than once a week?
2) Night Symptoms: Any night waking or night coughing due to asthma?
3) Any activity limitation due to asthma? (Runs/plays less than other children, tires easily during walks/playing?)
4) Reliever medication needed more than once a week?

Other risk factors for asthma exacerbations:
- Uncontrolled asthma symptoms
- One or more severe exacerbation in previous year
- The start of the child's usual 'flare-up' season (especially if autumn/fall)
- Exposures: tobacco smoke, indoor or outdoor air pollution; indoor allergens (e.g. house dust mite, cockroach, pets, mold), especially in combination with viral infection
- Major psychological or socio-economic problems for child or family
- Poor adherence with controller medication or incorrect inhaler technique
- Hospitalizations or PICU admissions for asthma in the year prior to visit, especially if patient required Intubation